Appalachian Cooperative Grouse Research Project:
Maryland Study Site Summary

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Background

Wildlife biologists in the mid and southern Appalachians have expressed concern over declining ruffed grouse *(Bonasa umbellus)* populations throughout the region. Some have postulated that the decline is a result of changing habitats, while others have suggested that late season hunting may be impacting grouse populations. In order to determine what was causing grouse declines, several state wildlife agencies agreed to jointly study this species. In 1996, Maryland joined the states of Ohio, Kentucky, Virginia and West Virginia in forming the Appalachian Cooperative Grouse Research Project (ACGRP). Soon after that, Pennsylvania, North Carolina and Rhode Island joined the study.

Factors limiting grouse populations outside aspen dominated habitats are poorly understood. Forest succession and habitat losses may be primary factors influencing ruffed grouse populations. Forest inventory data indicate early successional habitats are declining in the Appalachian region. Fragmentation of suitable grouse habitats may be occurring as timber harvesting declines and forests mature.

While the decline in the quality or quantity of early successional habitats is presumed to be a significant factor contributing to the apparent decline in grouse numbers, other causes have been suggested. These include various sources of mortality, both non-hunting and hunting related. Early research in northern climates suggested that grouse were an underutilized game species and could tolerate high harvest rates. Many states thus established long (Oct.-Feb.) grouse hunting seasons. However, recent research in northern latitudes suggests that grouse hunting mortality may be somewhat additive to natural mortality, and has greater population consequences late in the season (Dec.-Feb.) than early in the season during juvenile dispersal.

This research project was designed in 2 phases. Phase 1 investigated grouse population dynamics in 9 study areas located in 5 states. The first phase investigated basic population parameters and established possible hunting influences. Research into reproduction, survival and habitat relationships were also conducted during the first phase.

The second phase of the study looked into the effects of various hunting season structures. Hunting seasons were closed on selected study sites in an effort to determine if

survival rates differ. Additional research in Phase 2 examined hen condition prior to nesting and chick survival for the 2 months following hatching.

The objectives of the ACGRP were to:

1. Estimate survival rates and identify limiting factors for ruffed grouse populations.
2. Estimate reproductive rates and identify limiting factors to reproduction.
3. Determine if harvest is compensatory or additive.
4. Evaluate habitat selection and quality.

Methods

Ruffed grouse were trapped in late summer and fall months utilizing lily pad traps. Traps were placed in suitable grouse habitat on Mt. Nebo WMA and Garrett State Forest in Garrett County and checked once per day. Once removed from the trap, grouse were fitted with a necklace-style radio transmitter. Weight, sex, age and general condition of trapped birds were noted. Each grouse was also fitted with a reward leg band. Grouse were then released at the trap site within 20 minutes after removal from the trap. Study objectives were to place radios on 40 grouse during each fall trapping season.

All grouse were monitored twice per week throughout the year using radio telemetry equipment. All locations of birds were estimated by taking at least 3 compass bearings from known tracking locations. Bearings were mapped to determine approximate bird locations.

All radio transmitters were equipped with motion sensitive switches. These switches activated when the radio had not moved for 8 hours. It was assumed that a grouse was dead if the activity switch was activated. Researchers then located the radio collar and determined the cause of death for each grouse.

Each transmittered hen was closely monitored during the nesting season. Incubation dates, clutch sizes and hatching dates were determined from telemetry locations and nest checks. Chick survival was monitored by checking broods at 1, 3 and 5 weeks of age.

Habitat data was collected at all nest and brood sites. This data was compared to overall habitat availability to determine preferred brood habitat. Determining the relationship between habitat and grouse survival was a key objective of this research project.

Results

Trapping Success

Trapping success varied over the 6-year period. Grouse were trapped during the Fall of 1996, 1999 and 2000, and during the Spring and Fall of 1997, 1998 and 2001. A total of 228 grouse were trapped in Maryland during the 6-year study, with 118 females and 110 males captured (1.07/1.00 female/male ratio) (Table 1).

Table 1. Ruffed grouse survival rates by age class in Maryland, 1996 – 2002

	1996	1997	1998	1999	2000	2001	TOTAL
Total Grouse Trapped	24	30	49	38	39	48	228
Total Grouse Radioed with Known Fate	22	27	39	33	36	33	190
Total Juveniles Captured	16	14	24	27	27	22	130

Total Adults Captured	6	13	15	6	9	11	60
Juvenile Survival Rate [1]	5 (31.3%)	4 (28.6%)	9 (37.5%)	6 (22.2%)	10 (37.0%)	7 (31.8%)	41 (31.5%)
Adult Survival Rate [2]	5 (83.3%)	7 (53.8%)	7 (46.7%)	4 (66.7%)	6 (66.7%)	3 (27.3%)	32 (53.3%)
Adult Survival Rate [3]	5/6 (83.3%)	12/22 (54.5%)	11/29 (37.9%)	14/23 (60.9%)	10/23 (43.5%)	3/23 (13.0%)	48.9%
Annual Survival Rate (6/1-5/31)	45.5% (10/22)	44.4% (16/36)	36.4% (20/55)	39.2% (20/51)	40.0% (20/50)	22.2% (10/45)	37.9%

[1] Grouse captured as juveniles and surviving to the following June 1
[2] Grouse captured as adults and surviving to the following June 1
[3] Grouse captured as adults during that year and surviving to the following June 1, plus adults surviving from previous years and surviving to the following June 1, plus juveniles from previous years surviving to adult status and surviving to the following June 1.

Trapping success improved as personnel became more familiar with trapping techniques and when additional staff was incorporated to conduct additional trapping efforts. The most successful fall trapping period occurred during the Fall of 1999, when 1 grouse was captured for every 23 trap nights. Fall trapping success ranged from 1 grouse/70 trap nights in 1996 to 1/23 trap nights in 1999. Trap success has also been used to document reproductive success, suggesting that 1999 may have been the best production year of the 6 years of the study.

However, only 214 grouse were fitted with radio transmitters during the study. The sex ratio of transmitted grouse slightly favored females (116 females, 98 males). This was a result of not radioing captured males during the latter stages of the study. The ACGRP determined that female reproductive data was far more critical to this study, thus efforts were made to place more radios on females than males. Of the 214 grouse that were radioed, 190 had a known fate and were considered in the survival estimates (Table 1). The remaining 24 birds either left the study area alive and had an unknown fate or died before the 7-day acclimation period.

Males were generally larger than females. Males, on average, weighed 572 grams, while females weighed 510 grams. Juvenile males weighed more than juvenile females (553 g. and 495 g. respectively) while adult males were also larger than adult females (606 g. and 554 g. respectively).

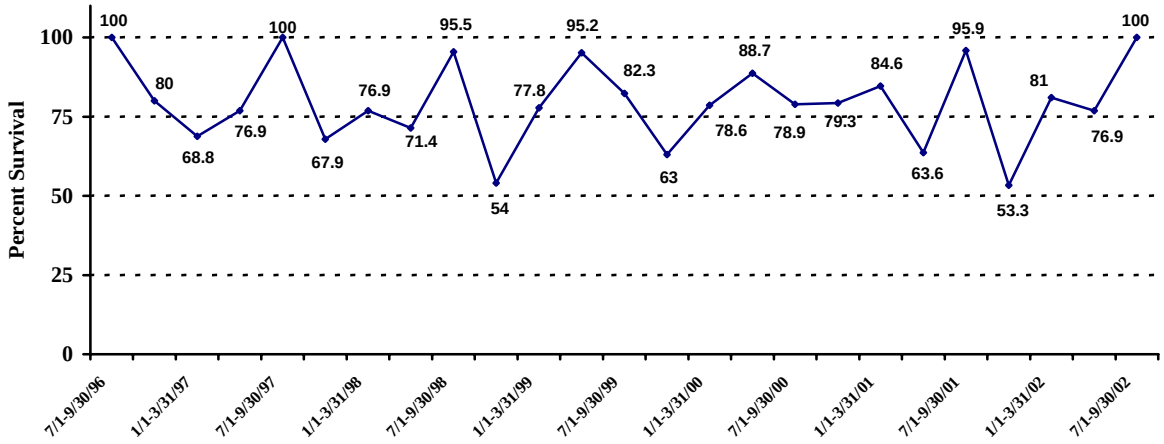
Survival

Survival of ruffed grouse is dependent on many factors. Habitat, weather conditions and predator populations are all paramount for grouse survival. In Maryland, grouse survival differed between age classes (Table 1). Juveniles survived at a lower rate than adults, as expected. Juvenile dispersal in September and October causes higher mortality due to increased movements at this time. Juvenile survival to adulthood (June 1) ranged from 22.2% in 1999 to 37.5% in 1998. Adult survival from capture date to the following June 1 varied from a low of 27.3% in 2001 to a high of 66.7% in 2001 (1996 is not included because there is no data from 1995 juveniles).

Once juveniles reached adulthood, they were included with adults trapped during the current trapping season. This provides a more realistic view of survival rates of adults as the adult sample size is increased. In 2001, adult survival rates decreased to 13.2%, and also dropped in 2000 to 43.5% (Table 1).

Annual survival rate from June 1 through May 31 was relatively constant in Maryland (Table 1). Survival of ruffed grouse on an annual basis was about 38%. However, annual differences were significant. In 2001, the annual survival rate was only 22.2%.

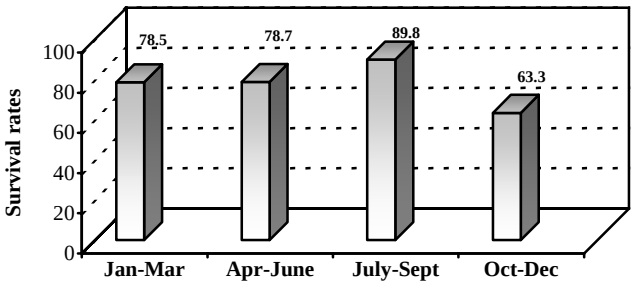
Figure 1. Seasonal ruffed grouse survival rates in Maryland, 1996-2002.



Seasonal survival rates in Maryland varied between years and seasons (Figure 1). Survival rates were lowest during the fall of 2001, when 24 of 45 grouse (53.3%) survived until January 1, 2002. The highest survival was reported for the summer of 1997 and 2002, when all 21 radioed grouse survived to September 1.

Combining data from all 6 years highlights seasonal survival differences more clearly. Birds that were captured during a quarter were assumed to be alive at the beginning of the quarter for seasonal survival rate estimates. Survival was highest during the summer months (89.8%) and lowest during the fall months (63.3%) (Figure 2.). One would expect survival to be highest during the summer when food and cover are abundant.

Figure 2. Maryland ruffed grouse survival rates by season 1996-2002.



It is somewhat surprising that survival is lowest during the fall months. Although dispersal occurs during the fall, and grouse become more vulnerable because they are moving more, one would think that survival would be lowest during the winter months when food and cover are least abundant. Apparently, higher mortality occurs in Maryland while birds search for suitable winter habitat rather than once they settle down in such habitat. Most juvenile grouse leave their family units and disperse from their brood ranges sometime between late September through early November. This period, sometimes referred to as the "fall shuffle," greatly increases their susceptibility to predators. Suitable dispersal habitat that provides protection from predators may be very important to grouse survival during this time.

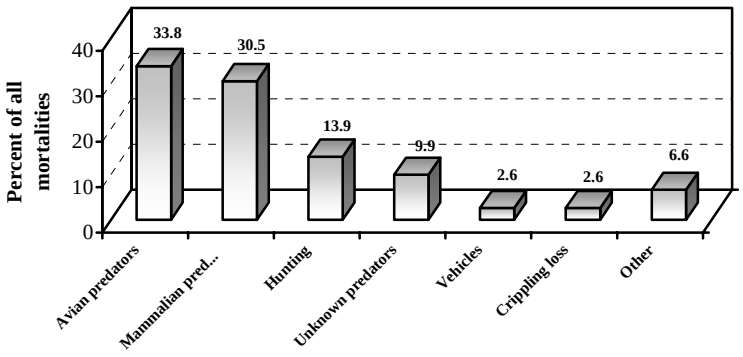
There was also a difference between sexes for the number of days that birds were alive (on the air). Grouse that were trapped and aged as adult males were on the air an average of 345 days after being radioed, while females were only on the air for an average of 235 days. Birds trapped and aged as juvenile grouse were on the air significantly less than adults but did not

differ between sexes. Juvenile males were on the air an average of 185 days, while juvenile females were on the air an average of 181 days. Adult birds that were trapped apparently had already survived the perils of juvenile life and were better able to survive than juvenile birds.

Mortality

Ruffed grouse die from a variety of causes, of which predation is the highest. In Maryland, avian predators killed slightly more grouse than mammalian predators (Figure 3). Avian predators caused slightly more than 33% of all mortalities, while mammalian predators caused a little more than 30% of all deaths. Another 10% of mortalities were classified as being caused by an unknown predator, bringing the predation rate to 74% of all recorded mortalities. Hunting was the second largest cause of mortality, comprising almost 14% of all mortalities.

Figure 3. Causes of ruffed grouse mortality in Maryland 1996 - 2002.



Mortality rates in Maryland also varied by month (Table 2.). The largest number of mortalities occurred in October when the number of radioed birds was the highest. November recorded the second highest number of mortalities, followed by December and January, respectively. Grouse activity is the greatest in October and November when juveniles disperse from family units and search for new habitats. Thirty-seven of the 109 predator caused mortalities occurred during these 2 months. Protective cover decreases during these months as leaf fall becomes complete, and increased grouse movements makes birds more susceptible to predators at this time of year.

Table 2. Ruffed Grouse Mortality by Month in Maryland, September 1996- September 2002

	Avian Predators	Mammalian Predators	Hunting	Unknown Predators	Vehicle Strike	Other	Total (%)
January	7	3	3	1	0	2	16 (10.6%)
February	0	2	0	2	0	1	5 (3.3%)
March	5	2	0	1	0	3	11 (7.3%)
April	3	3	0	2	1	1	10 (6.6%)
May	3	7	0	0	0	1	11 (7.3%)
June	3	2	0	0	0	0	5 (3.3%)
July	1	1	0	0	0	0	2 (1.3%)
August	0	1	0	0	0	0	1 (0.7%)
September	5	6	0	0	0	1	12 (7.9%)
October	10	12	8	2	1	1	34 (22.5%)
November	9	4	10	0	1	3	27 (17.9%)
December	5	3	0	7	1	1	17 (11.3%)
Total	51	46	21	15	4	15	151

Reproduction

Data was obtained from 35 Maryland grouse that attempted to nest during this study (Table 3.). Nest predators destroyed 13 of the 32 first nests (41%) during the nesting period. Five hens attempted to renest, with 3 renests hatching successfully. Clutch sizes in Maryland were similar for adult and juvenile hens averaging 11.5 eggs vs. 11.3 eggs, respectively. The number of eggs laid during the first nest attempt was substantially larger than second nest

Table 3. Ruffed Grouse Reproductive Data in Maryland

	1997	1998	1999	2000	2001	2002	TOTAL
Grouse attempting to nest	3	3	12	5	6	6	35
Successful first nests	2	1	5	3	3	5	19
Nests destroyed	1	1	6	1	3	1	13
Hens killed on nest	0	1	2	1	1	1	6
Number of renest attempts	0	0	3	0	2	0	5
Successful renests	N/A	N/A	2	N/A	1	N/A	3
Average clutch size of first nest (# of nests)	10.7 (3)	11.5 (1)	12.6 (11)	9.8 (5)	10.2 (5)	10.8 (5)	11.3 (30)
Average clutch size of second nest (# of nests)	N/A	N/A	7.0 (3)	N/A	6.5 (2)	N/A	6.8 (5)
Average clutch size of adult hens-first nest (# of nests)	13.0 (2)	11.5 (2)	12.0 (7)	9.5 (4)	11.5 (2)	11.0 (2)	11.3 (18)
Average clutch size of juvenile hens-first nest (# of nests)	9.0 (1)	N/A	13.5 (4)	11.0 (1)	10.5 (2)	10.7 (3)	11.5 (11)
First date of incubation (range)	5/1-5/19	4/30	4/24-5/29	4/25-5/5	5/2-6/1	4/29-5/5	4/24-6/1
Peak week of initiation of incubation (# of nests)	4/30-5/6 (2)	4/30-5/6 (1)	4/30-5/6 (4)	4/30-5/6 (4)	4/30-5/6 (3)	4/30-5/6 (4)	4/30-5/6 (18)
Hatching dates	5/25-6/12	5/24	5/21-6/22	5/22-6/1	5/26-6/19	5/27-6/6	5/21-6/22
Peak hatching week (# of nests)	5/21-5/27 (1)	5/21-5/27 (1)	5/28-6/3 (3)	5/28-6/3 (3)	5/28-6/3 (1)	5/28-6/3 (3)	5/28-6/3 (10)

attempts, averaging 11.3 eggs vs. 6.8 eggs. The start of incubation varied throughout the study. Incubation started as early as April 24 and as late as June 1. The later incubation dates were for renest attempts. The peak week of initiation of incubation was April 30 – May 6, when incubation began on 18 (56%) nests. Hatching dates of successful nests ranged from May 21 – June 22, with the peak hatching week occurring during May 28 – June 3 when 10 nests hatched (Table 3.).

Conclusion

Based on the findings of the ACGRP as a whole, the population ecology and habitat use of grouse in Western Maryland appears similar to most sites in the region. Survival, predation, and reproductive rates in Maryland were within the range of values found in other states. When

Maryland's data was combined with other sites, several significant findings became evident that have significant implications for future grouse management in the region.

Several ACGRP researchers found evidence supporting the theory that grouse in the Appalachians endure nutritional stress during the late-winter period in some sites and years. They found that grouse feed heavily on hard mast, primarily acorns and beechnuts, when available throughout the fall and winter. This highly nutritious food source appears to be important in maintaining the physical condition of hens on sites where other foods, such as fruits and buds of certain hardwood trees, are lacking. However, in years of mast failure, the health of nesting hens is negatively affected and the resulting chick survival is decreased. This relationship is presumed to be a result of a lack of nutrient reserves due to lower egg quality.

Another important finding of the research is that harvest from hunting at reasonable levels does not seem to impact grouse populations. All indications are that moderate harvests due to hunting are compensatory, meaning that hunters are simply harvesting grouse that would have died naturally at a later time. Current seasons and bag limits appear to have little to no effect on grouse numbers in the region and any population declines are more likely related to other factors such as habitat loss or variation in reproduction.

A wealth of information regarding habitat use was discovered by the ACGRP. Most was consistent with current theories regarding grouse habitat. Grouse favored areas with a high stem density, meaning areas with many small trees or saplings. Often these habitat conditions are found in approximately 8-20 year old clear-cuts. However, grouse in the Appalachians also used more mature forests with well-developed understories, possibly due to their reliance on hard mast.

Based on these and other findings, grouse management techniques can be refined in the future. Hunters can be confident that the birds they take home are not impacting overall grouse numbers. Timber harvests that produce young forests continue to be the most valuable tool to manage grouse habitat and hold the most potential to increase grouse populations in the Appalachian region.

For more information on the findings of the ACGRP, review the final report on DNR's website http://www.dnr.state.md.us/wildlife/acgrpr_finalreport1.pdf